Signals

Any physical phenomenon (or quantity) that conveys or carries some information can be called a signal. This signal varies with time, space or other variable. Some of the most common signals in our daily life are, music, pictures, photos, and more deeply, speak signal, heart rate, blood pressure, and so on. In fact, the meaning of a signal different from one field to another depending on the domain (or fields) it is associated with such as:

- ✓ In electronics and telecommunications, signal refers to any time-varying voltage, current, or electromagnetic wave that carries information.
- ✓ In signal processing, signals are analog and digital representations of analog physical quantities.
- ✓ In information theory, a signal is a codified message, that is, the sequence of states in a communication channel that encodes a message.
- ✓ In a communication system, a transmitter encodes a message to create a signal, which is carried to a receiver by the communication channel. For example, the words "Mary had a little lamb" might be the message spoken into a telephone. The telephone transmitter converts the sounds into an electrical signal. The signal is transmitted to the receiving telephone by wires; at the receiver it is reconverted into sounds.
- ✓ In telephone networks, signaling, for example common-channel signaling, refers to phone number and other digital control information rather than the actual voice signal.

Accordingly, the signal may also be defined as any observable change in a quantity over space or time (a time series), even if it does not carry information.

Signal representation

Many forms to represent the signals, the important are:

- Functional representation

  Ex. $x(n)=\frac{n+1}{2}$ $0 \leqslant n \leqslant 4$

- Tabular representation

n	0	1	2	3	4
x(n)	1/2	1	3/2	2	5/2

- Sequence representation

  x(n)= {1/2, 1, 3/2, 2, 5/2}

- Graphical representation

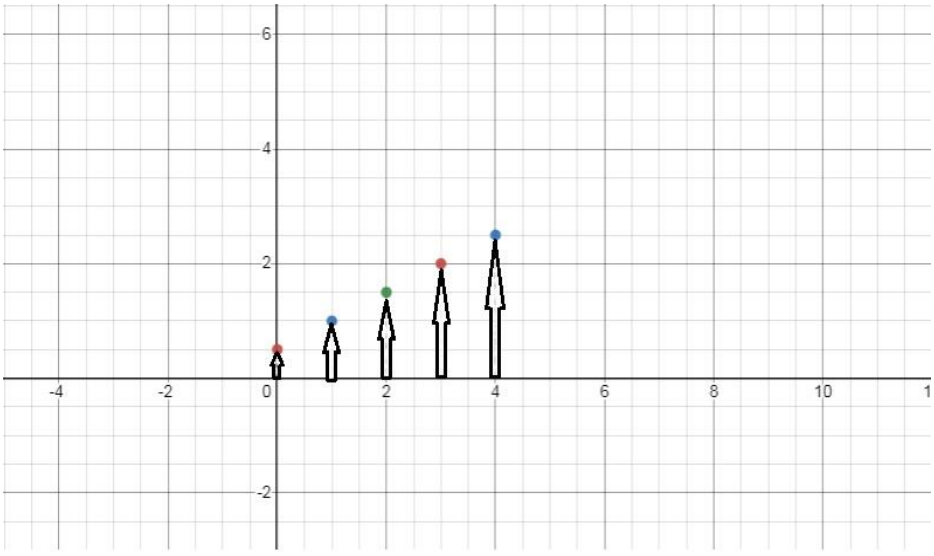

Figure 1: Graphical representation of a signal

In general, a signal is defined as any physical quantity that varies with one or more independent variables.

X (t) = 0.7 t (vary linearly with time)

X (t) = 1.8 t^2 (vary quadratically with time)

Usually, the information carried by a signal will be a function of independent variable, one or more. The independent variable can be time, spatial coordinates, intensity of colors, pressure, temperature, etc.

- Amplitude is the value of a signal at any specified value of the independent variable. Another definition of signal amplitude that is height or power of the wave.
- Waveform is the sketch or plot of the amplitude of a signal as a function of independent variable.

Mathematically, any signal can be represented as a function of one or more independent variables.

Classifications of signals

Signals can be categorized in various ways. The most common distinction is between discrete and continuous spaces that the functions are defined over, for example, discrete and continuous-time domains.

◈ ***Continuous-Time vs. Discrete-Time***

As the names suggest, this classification is determined by whether or not the time axis is discrete (countable) or continuous.

A continuous-time signal will contain a value for all real numbers along the time axis. In contrast to this, a discrete-time signal, often created by sampling a continuous signal, will only have values at equally spaced intervals along the time axis.

Indeed, in digital signal processing, a digital signal may be defined as a sequence of discrete values, typically associated with an underlying continuous-valued physical process. In digital electronics, digital signals are the continuous-time waveform signals in a digital system, representing a bit-stream.

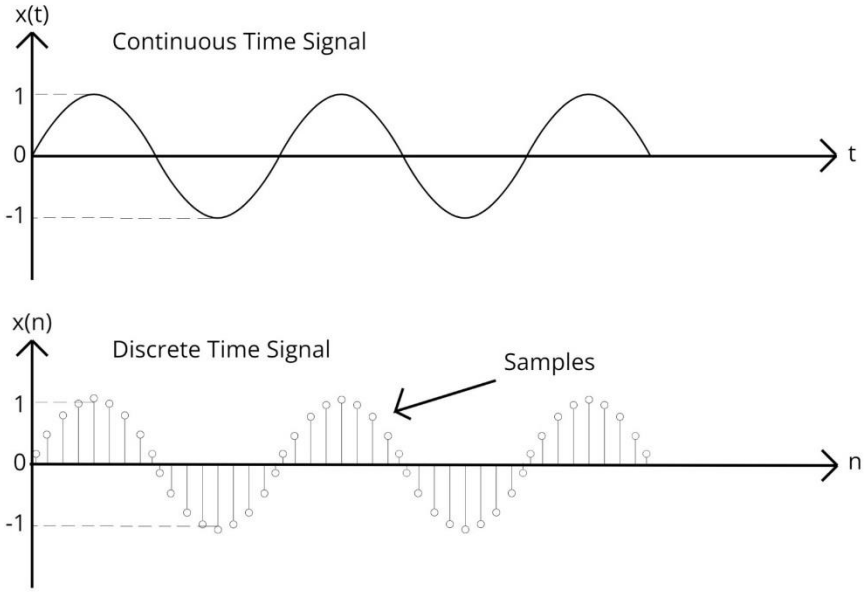

Figure 2: CTS and DTS

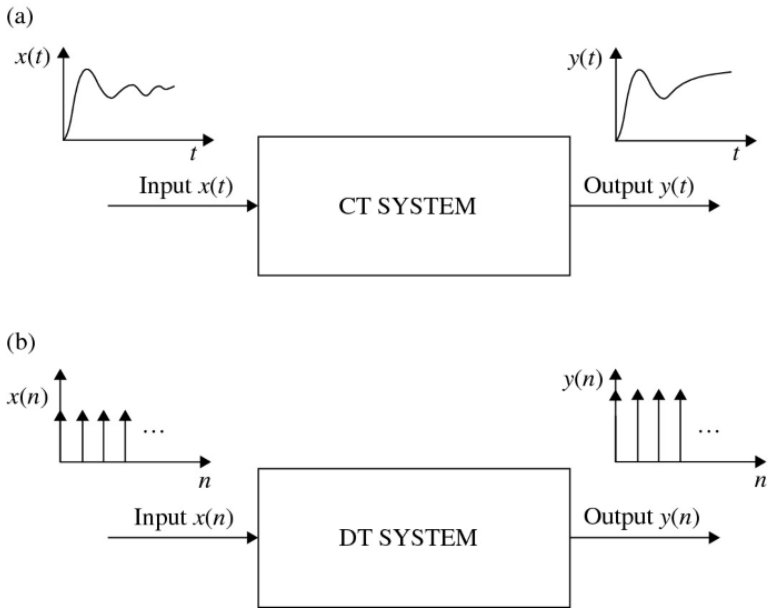

Figure 3: System based on a signal type

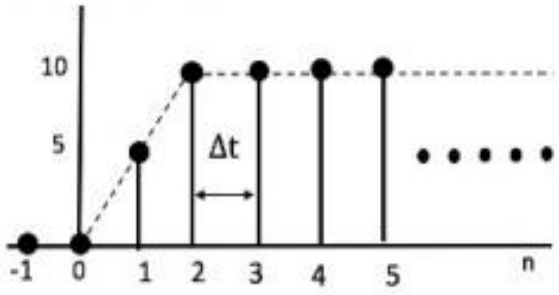

Figure 4: Uniform signal

Ex. Draw the graph when x {n}= {1,0,1,2,2,1}